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IMMATURE STAGES AND BIOLOGY OF *POSTTAYGETIS PENELEA* CRAMER (LEPIDOPTERA: NYMPHALIDAE: SATYRINAE)

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Abstract.—*Posttaygetis penelea* Cramer larvae are common in bamboo understory, present year round, and can be found in a wide variety of habitats. Larvae specialize on woody bamboos within the genus *Guadua* (Poaceae), and adults are highly associated with bamboo groves. The presence of the host plant is the only important habitat requirement for this species, in that they can be found within bamboo groves in forest habitats, forest edges, and pastures. The immature stages of *P. penelea* are described and head capsules and chaetotaxy are illustrated. Both larvae and pupae possess distinct features which separate this monotypic genus from the closely related genera *Taygetis* Hübner and *Pseudodebis* Forster.

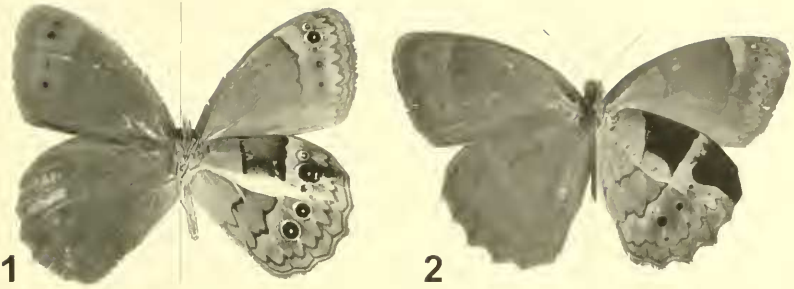
Key Words: Euptychiina, Satyrinae, *Taygetis*, *Pseudodebis*, bamboo, larvae, specialist, chaetotaxy

Posttaygetis Forster (1964) is a monotypic butterfly genus within the diverse satyrine subtribe Euptychiina (Nymphalidae: Satyrinae). *Posttaygetis penelea* (Cramer 1777) occurs throughout the Amazon basin to southern Brazil and was recently collected as far north as Nicaragua (Maes 1995). Individuals are normally encountered within lowland *Guadua* bamboo groves (Poaceae), although I collected a worn specimen from premontane forest (Wilson Botanical Garden, Costa Rica, elevation 1,110 m).

Posttaygetis penelea is easy to recognize by the combination of somber satyrine markings and a bright yellow band traversing the ventral hind wing (Fig. 1). This yellow band is greatly reduced or absent in the one named form, *P. penelea* var. *penelina* (Staudinger 1888), found in southern Brazil (Fig. 2). Forster (1964) provided no information on delineation of the *Posttaygetis* other than commenting that it is distinguished by structures of the male genitalia. However, larvae possess several distinctive features which separate this species from the closely related genera *Taygetis* Hübner and *Pseudodebis* Forster. These diagnostic characters, along with the immature stages, are described in this paper.

Materials and Methods

Larvae and eggs were located in the field by searching known host plants and by observing female oviposition. Specimens were reared individually in plastic containers, and fresh host plant was added every two to three days. Appearance, behavior, and development times were noted for all stages. Larvae were preserved in 95% ethanol after being immersed in boiling water for several seconds. Vouchers are deposited in the National Museum of Natural History, Smithsonian Institution, Washington DC. Much of the work for this study was conducted in Ecuador at Jatun Sacha Biological



Figs. 1–2. Adults, dorsal view on left, ventral view on right. 1, *Posttaygetis penelea*, male, Ecuador, Napo Prov., Puerto Misahualli. 2, *P. penelea* var. *penelina*, male, Brazil, Mato Grosso, Chapada [BNHM].

Station, Napo Province, during 1990 to 1993. Some comments on adult natural history, in particular observations on habitat associations, are taken from data gathered during a year long trapping study conducted at that site (DeVries et al. 1997).

Setal names for the head capsule follow Heinrich (1916), with modifications as incorporated by Stehr (1987). Body chaetotaxy follows Hinton (1946). More detailed information on euptychiine morphology can be found in Murray (2001). Head capsule width is measured by the distance between the third stemmata. Instar durations are given as averages of five individuals.

Results

Posttaygetis penelea Cramer

Diagnosis.—*First instar:* No unique features separate species from other euptychiines other than combination of larger size, head capsule primary setae terminating in a fine point, and extremely dense pattern of ridges on head capsule surface, which extend medially to A2 (Fig. 3).

Second and third instar: White band bisecting dorsal aspect of head capsule, expanding medially; four large apical setae on head horns, P1, P2, and two secondary setae (Fig. 4–5); slender green body with white, broad dorsolateral stripe; caudal filaments projecting dorsolaterally.

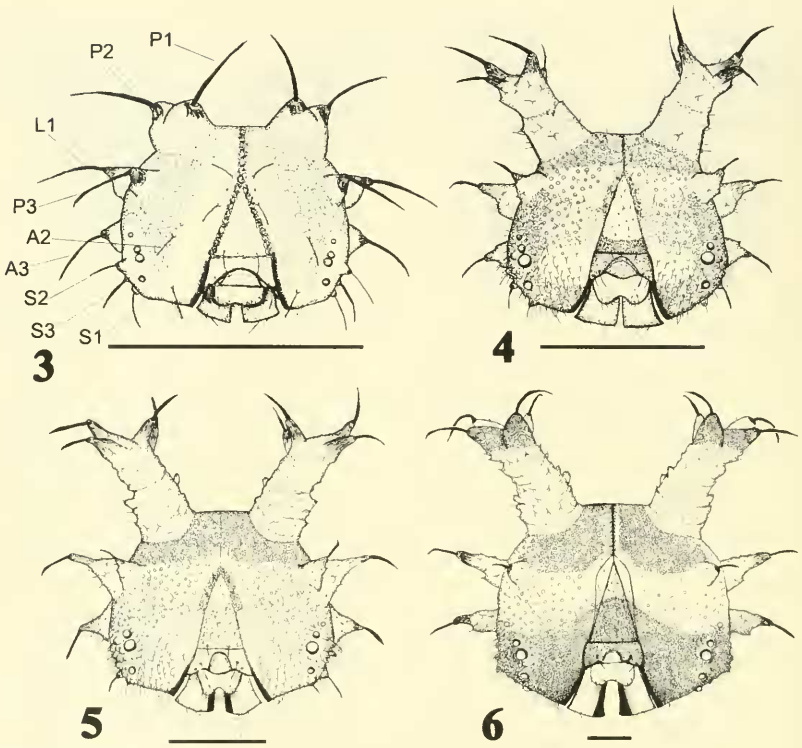
Fourth instar: White band bisecting dorsal aspect of head capsule; head horns and lateral lobe setal bases elongated; four large apical setae on head horns, P1, P2, and two secondary setae with large setal bases and long, recurved setae (Fig. 6); specialized setae bordering epicranial suture terminating at apex of adfrontal area; body with green and brown dorsolateral slashes forming broad inverted "v" in dorsal view.

Pupa: Four prominent pairs of tubercles dorsally on abdomen (Fig. 10).

Description.—*Egg:* Shiny, round, semitransparent, pale white to pale green (n = 28). Duration 6.0 days.

First instar: Head capsule 0.8 mm; black; lobe setae (P1, P2, P3, L1, and A3) long, narrow, terminating in a fine point; lobe setae basally thick but not flattened; P1 located more basal than P2; dense dendritic pattern of ridges on the head capsule integument (Fig. 3). Body shiny dark green; D1 and D2 shorter than XD1 and XD2 on prothoracic segment (Fig. 7); SD1 on T1 and A9 sensory with long, filamentous seta; D1 and D2 approximately equal on all abdominal segments except A8 and A9, where D1 larger than D2 (Fig. 8); caudal filaments short, rounded (n = 17). Duration 4.8 days.

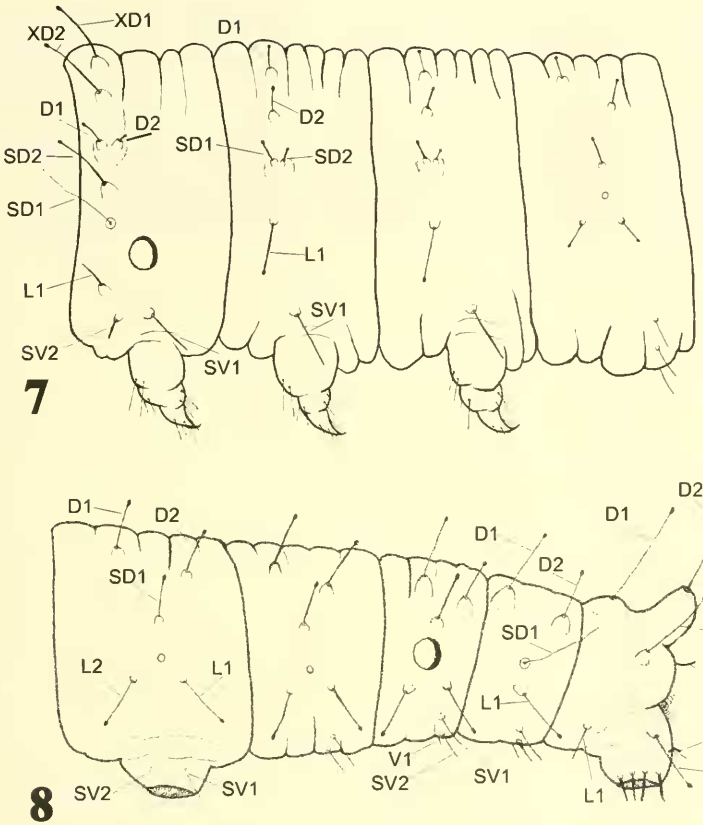
Second instar: Head capsule 1.2 mm; light brown darkening to brown one to two days after molting; head horns and lateral



Figs. 3–6. Head capsules of *Posttaygetis penelea*, frontal view (scale = 2.0 mm). 3, First instar. 4, Second instar. 5, Third instar. 6, Fourth instar.

head capsule dark brown; apical portion of frons outlined in dark brown; lateral setal lobes white; distinctive white band extending between P3 setae, widening medially (Fig. 4); head horns large, projecting slightly anteriorly, with two large apical secondary setae in addition to P1 and P2; lobe setae long, flattened, and twisted, at least as long as sclerotized base; P3 thinner and shorter than other setae; lateral lobe setal bases white; S2 setae long, flattened, and twisted. Body bright green with bright white dorsolateral stripe; caudal filaments pink and projecting dorsolaterally; numerous secondary setae on body; primary setae indistinguishable from surrounding secondary setae except for SD1 sensory setae on T1–T3, A4, A5, and A9; integument covered with fine microgranulations (n = 14). Duration 4.9 days.

Third instar: Head capsule 1.9 mm; same as in previous instar except dark brown, basally reddish brown; head horns with white basal stripe; P3 considerably smaller than other lateral lobe setae (Fig. 5). Body dark green; median dorsal stripe faint reddish green, outlined by undulating white lines on abdomen only; dorsolateral band



Figs. 7–8. Body chaetotaxy of first instar *Posttaygetis penelea*. 7, T1–A1. 8, A6–A10.

broad, bright white to yellow, and extending laterally on caudal filaments; thin white line laterally; caudal filaments pink apically and projecting dorsolaterally; body chaetotaxy same as previous instar (n = 18). Duration 5.0 days.

Fourth instar: Head capsule 3.1 mm; dark brown; reddish brown basally and laterally; white basal stripe; white band as in previous instar; P1 and P2 flattened, recurved, and one and a half times length of setal base; two secondary apical setae on head horns as large as P1 and P2; specialized setae bordering epicranial suture from apex of adfrontal area to head capsule base, curving over suture and criss-crossing setae on opposing side (Fig. 6). Body pale brown (Fig. 9); prothoracic shield green; dorsal median stripe on thorax rust brown outlined thinly in dark brown; dorsal median stripe on abdomen green, often fading to greenish brown as instar progresses, outlined with thin white undulating lines; green coloration extends dorsolaterally on each seg-

Figs. 9–10. *Posttaygetis penelea*. 9, Mature larva, dorsal view. 10, Pupa, lateral view.

ment, forming a broad "v" pattern in dorsal view; fine lines of brown and white laterally; black spots dorsolaterally, two per segment, on T2, T3, A1, and A9; spots variable in size and may not be present; large prominent dark brown spot laterally on A3 to A4, tapering smoothly to form a line on A5 through A6 and bordered ventrally by bright cream line; caudal filaments green; chaetotaxy of SD1 sensory setae same as previous instar; secondary setal bases on body covered in fine microgranulations; specialized setae within thoracic dorsal midline stripe, setae similar in morphology to specialized setae on head capsule, not found elsewhere on body (n = 23). Duration 8.8 days.

Pupa: Dark brown with green and pale brown markings (Fig. 10); compressed; dorsal apical point on thorax knobbed, projecting anteriorly; four prominent tubercles dorsally on abdomen (n = 12). Pupates flat against substrate. Duration 9.8 days.

Biology.—*Posttaygetis penelea* adults are encountered in and around *Guadua* bamboo groves. At Jatun Sacha, Ecuador, adults were present in all months of the year, but were never abundant (DeVries et al. 1997). All individuals trapped were from sites in forest habitats containing bamboo (n = 25). Within the bamboo groves males defend small sunlit patches but do not exhibit lekking behavior that occurs in many *Taygetis* species (Murray 2001). Females oviposit in late afternoon, usually from 4:00 until dusk, and often remain in small, localized areas to select oviposition sites.

Larvae specialize on bamboo (*Guadua* sp.). Mature larvae provided with two herbaceous bamboos (*Olyra latifolia* L. and *Pariana* sp.) and one grass species (*Orthoclada laxa* (Rich) P. Beauv.) did not feed. Eggs are laid singly on small bamboo shoots in the understory. Although bamboo groves are comprised of a substantial amount of plant biomass, most is in the canopy, with only isolated resprouts, young plants, or new growth in the understory. For butterflies restricted to understory sites, the number of oviposition sites can be limiting. There can be up to a half dozen *P. penelea* eggs on the underside of some leaf blades.

Although adults are not commonly encountered in the field, the immature stages of *P. penelea* are often easily located in suitable bamboo habitat. This species does not appear to go into reproductive diapause in the upper Napo region of Ecuador, as larvae are present year round. Systematic searches for larvae were conducted at Jatun Sacha, including bamboo groves located in forests, forest edges, and open pastures. *Posttaygetis penelea* larvae were found in all habitats and were the only euptychiine bamboo feeders found in isolated bamboo groves in pastures.

Discussion

Despite the paucity of information provided by Forster (1964), several unique lar-

val characters were found that support *Posttaygetis penelea* as a valid genus. *Posttaygetis penelea* was originally placed within *Taygetis*, and the larvae share many morphological traits. Most notable of these traits are the retention of both P1 and P2 setae at the apex of the head horns and the enlarged primary setae on the head capsule. However, *P. penelea* differs from closely related species by the presence of two large apical secondary setae between P1 and P2 on the head horns, the distinct white or dark brown band transversing the head capsule, and the widely spaced caudal filaments, which project dorsolaterally, albeit weakly, in later instars. In the fourth instar, the distribution of specialized setae bordering the epicranial suture is also an important diagnostic character, with the setae terminating at the apex of the adfrontal suture. Other euptychiines either do not possess these setae, or the setae are found on the adfrontal area and/or frons. *Posttaygetis penelea* pupae differ from *Taygetis* and *Pseudodebis* pupae by their compressed shape and large tubercles on the abdominal dorsal surface. There are differences in ecological traits as well. Most *Taygetis* species are crepuscular and many males exhibit lekking behavior (Young 1984, Murray 2001). In contrast, *P. penelea* is diurnal and males do not form leks. Also, females of *Taygetis* bamboo specialists oviposit at dusk in the canopy, not in the understory as *P. penelea*.

There is only slight color change within each instar as the larvae develop, a trait commonly found in *Taygetis* larvae (Murray 2001). Unlike many satyrines, *P. penelea* larvae and pupae are not polymorphic. Other than the previously noted named form, *P. penelea* var. *penelina*, there is also little variation in wing pattern, which can be highly variable in related *Taygetis* species. This form is reported to occur near the southern edge of the species' distribution, but I have collected individuals from the Ecuadorian rainforest that also lack the distinctive band, although I have never reared an individual. Most likely this form is present in many *P. penelea* populations, but in low numbers.

The fact that the immature stages of *P. penelea* have not been described yet is somewhat surprising. As noted earlier, larvae are common in the bamboo understory, present year round, and can be found in a wide variety of habitats, including pasture, as long as bamboo is present. Indeed, the presence of bamboo is the only important habitat requirement, suggesting that this species is not heavily impacted by habitat disturbance. This result was also found by Singer and Ehrlich (1991) for several other specialist euptychiines.

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